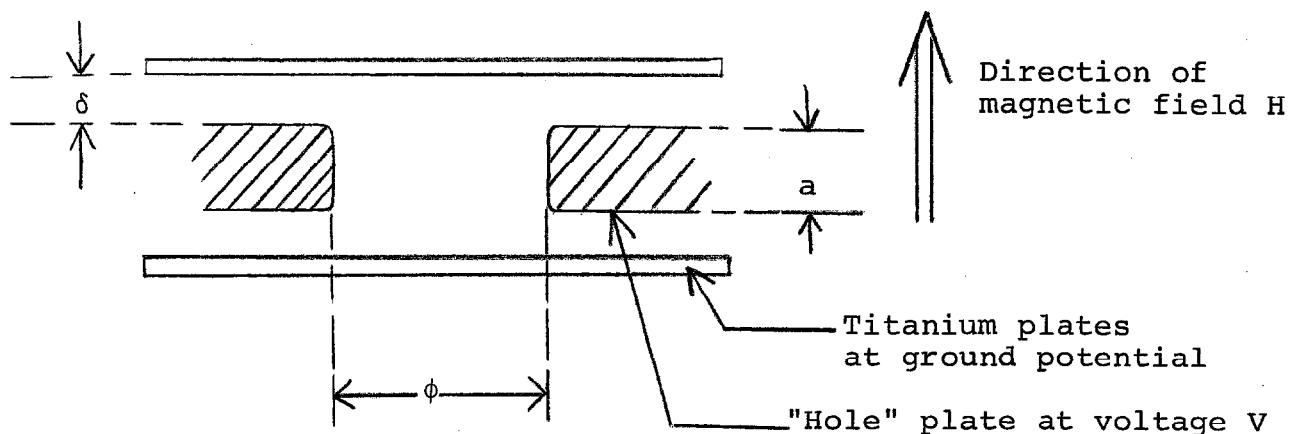
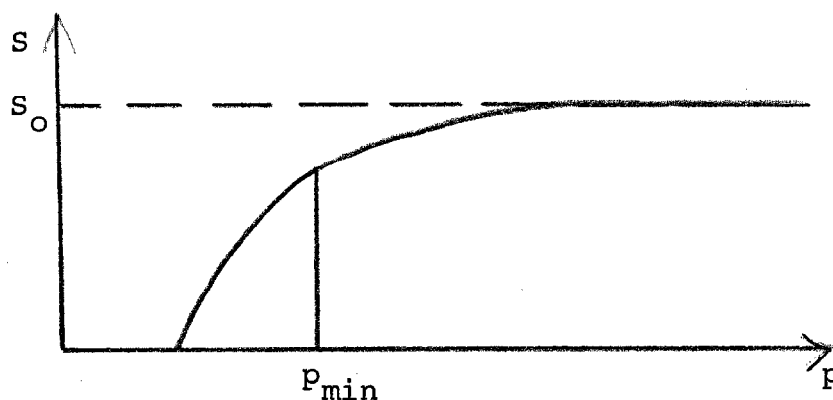
 national accelerator laboratory	Author L. C. Teng	Section Theory	Page 1 of 3
	Date 10/28/68	Category 0100	Serial TM-84

Subject **EMPIRICAL FORMULAS FOR ION PUMPING -**
INFORMATION OBTAINED FROM NUCLEAR PHYSICS INSTITUTE, NOVOSIBIRSK

The geometry of a single pumping hole is shown below



The pumping speed S versus pressure p curve looks like



showing that the pumping speed per hole is essentially constant S_0 down to some minimum pressure p_{\min} . Some simple characteristics are the following:

- (1) The effect of δ is only in the conductance of gas to the hole opening because the gas has to diffuse through the gap δ to reach the hole opening where it is then pumped out. Neither S_0 nor p_{\min} depends on δ .

(2) The dependence of S_o and p_{min} on the magnetic field strength H is only through the combination $H\phi$. Therefore smaller hole diameter can always be compensated by higher magnetic field.

$$(3) \quad p_{min} \text{ (torr)} = \frac{5 \times 10^4}{\phi^3 V \left(H\phi - \frac{3.6 \times 10^5}{H\phi} \right)^3}$$

where

$$\left\{ \begin{array}{l} H \text{ in gauss} \\ \phi \text{ in cm} \\ V \text{ in volts} \\ p_{min} \text{ in torr} \end{array} \right.$$

$$(4) \quad S_o \text{ (liter/sec)} = 2.5 \times 10^{-6} a \sqrt{V} \left(H\phi - \frac{3.6 \times 10^5}{H\phi} \right) \left(1 - e^{-2.5\phi} \right)$$

where

$$\left\{ \begin{array}{l} H \text{ in gauss} \\ a \text{ and } \phi \text{ in cm} \\ V \text{ in volts} \\ S_o \text{ in liter/sec} \end{array} \right.$$

(5) The range of validity of these relationships has been experimentally tested to be

$$\left\{ \begin{array}{ll} a \text{ and } \phi & = 0.15 \text{ to } 5 \text{ cm} \\ V & = 1 \text{ to } 10 \text{ kV} \\ p & = 10^{-5} \text{ to } 10^{-10} \text{ torr} \\ H & = 0.5 \text{ to } 12 \text{ kG (actually tested but believed} \\ & \text{to be valid to } 20 \text{ kG)} \end{array} \right.$$

(6) As an example we take

$$\begin{cases} a = \phi = 1 \text{ cm} \\ V = 5 \text{ kV} = 5 \times 10^3 \text{ volt} \\ H = 20 \text{ kG} = 2 \times 10^4 \text{ Gauss} \end{cases}$$

Then we get

$$\begin{cases} p_{\min} = \frac{1}{8} \times 10^{-11} \text{ torr} \\ s_o = 3.2 \text{ l/sec per hole} \end{cases}$$